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Current Trends of Economic Modelling of Sustainable Corporate Performance and Reporting – Review and Research Agenda

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Abstract

Currently there is a massive deployment of information and communication technologies in modeling of advanced quantitative methods (optimization, stochastic and dynamic programming) in economy. Also, there is a deployment of methods from the field of artificial intelligence (neural networks, genetic algorithms) in order to construct a mathematical decision model applied in the economic sphere. Accuracy of the experiment economy can be improved by including non-deterministic factors (uncertainty, uncertainty, risk).

The purpose of this paper is to identify current and future directions for research of economic modelling of sustainable corporate performance and reporting, which include environmental indicators (measuring the environmental impact on resources), social indicators (health and safety, human rights, ethical behavior etc.), corporate governance indicators (related to efficiency, structure and responsibilities of the governance) and the economic value of the company, where is considered combination of Sustainable Value Added, Economic Value Added and Data Envelopment Analysis methods. The solution is to analyze the possibilities of the method of artificial intelligence, when you build a descriptive model of a decision support system, aimed at simplifying the decision process.

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Keywords: corporate performance; key performance indicators; sutainability; economic modelling; EVA; SVA; DEA

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1. Introduction

The basic objective of most Czech companies is generally seen as maximizing and increasing the market value in the longer term. In the context of the *Corporate Performance Measurement System (CPMS)*, the division of approach of corporate performance evaluation is promoted by means of financial and non-financial indicators, which is the same with many authors (Grigoroudis et al., 2012; Kocmanová, Hřebíček et al., 2013; Searcy, 2012).

The basic principle of the introduction of non-financial indicators to the company management is the fact that very often the financial indicators for evaluating the corporate performance are not sufficient. Due to the impact of global markets and global trends there is a need to assess the overall corporate performance by using the *Sustainability Indicators* (G4 Guidelines, 2013a, 2013b), integrating the strategy into one *Integrated Reporting* (Eccles, Krzus, 2010; IIRC, 2011, 2013; Kocmanová, Hřebíček et al., 2013).

As we have already stated, using financial indicators measurement is not an essentially relevant tool of explanation designed for investors, and, therefore, there is a need to evaluate and compare the integrated corporate performances by creating such indicators, ones which would possess sufficient explanatory skills concerning the *Environmental, Social, Corporate governance* (ESG) and *Economic performance* (Bassen, Kovacs, 2008; Garz et al., 2010; Kocmanová, Hřebíček et al., 2013).

The integration of ESG performance indicators is probably the best way to measure the corporate sustainable performance on the basis of the concept of sustainable financial value (based on the integration of ESG issues within the standard financial framework) (Kocmanova et al., 2011, 2012; Hřebíček et al., 2011, 2012).

Corporate performance in the current economic theory and practice is measured most frequently by using added economic value, i.e., using the *Economic Value Added* (EVA) indicators (Stern, Stewart, 1994; Sharma, Kumar, 2010; Qi, 2011). The EVA indicator, from the perspective of financial management, combines all the essential ingredients, namely: the effect of calling the company an absolute dimension of invested capital and its price.

The question of how to establish a *Sustainable Value Added* (SVA) indicator has asked by Figge and Hahn (2002) and the same have defined the method of the SVA calculation. This method takes into account the values that a company generates when interacts with the environment. The SVA model was first published (Figge, Hahn, 2002), whose built it on the basis of the earned value of the company compared with a benchmark, assuming the same impact of both companies on the environment. The benchmark may be another company, sector, national economy, an international fixed target quantity value of economic and environmental variables (Figge, Hahn, 2004).

For the purposes of doing performance benchmarking (metric benchmarking), a usable method is the *Data Envelopment Analysis* (DEA) and the *Stochastic Frontier Analysis* (SFA). The DEA method has a widespread application in economics, for example it is used for example to assess the effectiveness of the R&D investment (Lee, Park 2005; Zhu 2003, 2009), performance evaluation and benchmarking (Jablonský, 2002; Jablonský, Dlouhý, 2004), etc. The DEA method is gradually being enriched and modified, for example *Fuzzy DEA* (Guo, Tanaka, 2001), *Network DEA* (Färe, Grosskopf, 2000), combined with other methods, for example with the *Analytic Hierarchy Process* (AHP) method (Tseng, Lee, 2009).

Corporate sustainability is engaged in many international organizations and is studied from various points of view, including the determination of the appropriate set of indicators. Unfortunately, however a company's contribution to sustainability is still hard to measure. The fundamental problem of Czech companies we see in the paradox that professes to sustainability, but only a small percentage of them can prove their actual tackling sustainability. It can be argued that empirical research on corporate sustainability on the basis of the SVA so far at the Czech company does not exist. For the measurement and management of sustainability of the SVA model can be based on the concept (Fige, Hahn, 2002, 2004; Hahn et al., 2007). However, even its authors are aware that the SVA model does not sufficiently, whether the value of the company is sustainable.

Therefore, we will focus on the solution of the problem of a complex assessment of corporate sustainability measurement using the SVA with regard to ESG indicators, EVA, models for the evaluation of the effectiveness and performance of companies and the DEA, which is compared to each other.

We are looking for a model for the measurement of corporate sustainability then it will be possible to verify and compare the sustainability of companies in selected sectors (e.g. in agriculture and food processing sector). Research will be carried out using the linked open data and information obtained from the Czech Statistical Office (CZSO) and Eurostat, the Ministry of Environment (MOE), the Ministry of Trade and Industry (MTI), the Ministry of

Agriculture (MA), the AMADEUS database[†], and also annual reports, corporate sustainability reports based on framework of the Global Reporting Initiative (GRI 2014) etc. and Czech, European legislative requirements.

The research team of the Faculty of Business and Management of Brno University of Technology and the Faculty of Business and Economics of Mendel University in Brno finished the three year project Reg. No. P403/11/2085 "Construction of Methods for Multi-factorial Assessment of Company Complex Performance in Selected Sectors" in December 2013 and started new research within the three year project Reg. No. 14-23079S "Measuring corporate sustainability performance in selected sectors" from January 2014. These projects were/are funded by the Grant Agency of the Czech Republic. The aim of this paper is identify current and future directions for research of economic modelling of sustainable corporate performance and analyze the possibilities of the method of artificial intelligence based on which we build a descriptive model of a decision support system, aimed at simplifying the process.

2. Corporate performance and sustainability measurement – Current state of research

How to design, implement and validate a model of *corporate performance and sustainability* (CPS) *measurement* and *integrated reporting*? We can use *Political, Economic, Social* and *Technological* (PEST) analysis introduced Healy (1994) and developed by Scott and Carrington (2011) and we can combine this with *Strengths, Weaknesses, Opportunities* and *Threats* (SWOT) analysis (Hill, Westbrook, 1997) to identify the current state of the CPS measurement. Furthermore, advanced mathematical, econometric and statistical methods, information and communication technologies can be used similarly as in the project P403/11/2085 in selected sectors of the economy of the Czech Republic (NACE codes: Manufacturing subsections 26–33, Agriculture, hunting and related service activities section 01 and Manufacture of food products and beverages subsection 15) (Kocmanová, Hřebíček et al., 2013). We can also use the developed software which is available to the public and companies of these selected sectors on the web (GACR403, 2013). This software issued from GRI (G4 Guidelines, 2013a, 2013b), IIRC (IIRC, 2013), SAFA (SAFA Guidelines, 2013) frameworks and Křen method (Křen, 2011).

2.1. Current state of research – Methods of CPS modelling

The current research methodology of CPS measurement is based on three main pillars of theoretical foundations, which are: *model measuring SVA inclusion of ESG performance indicators* and *DEA models for assessing the corporate effectiveness and performance*, and *benchmarking*. We summarized these in introduction.

The level of experiments of CPS measurement may be elevated by also considering significant aspects of qualitative character, mainly consisting in capturing nondeterministic facts (indeterminateness, uncertainty, risk).

Economic, environmental as well as social experiments are difficult to control and to repeat. This is necessary in the implementation of the methods properly taken into account, including the specific boundary conditions, the historical development of a multi-criteria decision making. This fact must be respected. The resulting method should be modifiable, enabling e.g. respect the local specification, changes of marginal conditions, possibilities of a reasonable prediction, deduction from historical development, multi-criteria decision-making, ability of further simplification, resp. comparison, etc.

The process of creating models of real situations (in general, not just in economics) may be called "*real phenomena modelling*". Modelling may be categorized from different points of view. When modelling employing advanced quantitative methods, optimization, stochastic, dynamic, further mathematic (e.g. disaster theories) and other methods, the level of examination may be increased by also considering significant aspects of qualitative character, mainly consisting in capturing facts nondeterministically, e.g. by capturing phenomena under conditions of indeterminateness, by means of data extraction, by considering and reflecting upon uncertainty not just by "*measuring*" of empirical data, but also uncertainty of methods, technology, the facts that economic, environmental

[†] https://amadeus.bvdinfo.com/

as well as social experiments are difficult to control, by taking into account degrees of phenomenal ambiguity, delimiting certain balance space etc. (Fábry, 2007).

We will rely on *ESG performance indicators*, which include environmental indicators (measuring the environmental impact on resources), social indicators (health and safety, human rights, ethical behaviour, etc.), corporate governance indicators (related to efficiency, structure and responsibilities of the governance) and the economic value of the company (Kocmanová, Hřebíček et al., 2013).

When dealing with research, we will be based on the basic approaches for *Sustainable Value Added* (SVA) measuring, where absolute and relative SVA were defined Figge and Hahn (2004a). The relative SVA provides a comprehensive picture of the status of value added to company sustainability. From an economic point of view we understand the value approach based on the basis of resources, which takes a holistic approach to value creation, and is based on the interaction of resources. Porter and Kramer (2011) dealt with the concept of values, which is supposed to represent the benefits for the company. They point out that the sight of internal economic costs is necessary to extend the social costs and benefits that would contribute to long-term sustainability. The environmental resources we can look like on eco-efficiency (Figge, Hahn, 2002). Eco-effectiveness describes the degree to which the company makes use of the environmental resources in reverse proportion to its economic output (e.g. CZK/tonne CO_2). Social-efficiency can be calculated as the ratio of the added value of the social impact of the activities of the undertaking (e.g. CZK/work injury) (Figge, Hahn, 2002). Environmental and social (added) value, the value increases or decreases, due to the use of a given quantity of environmental or social resources in an enterprise with the benchmark.

Data Envelopment Analysis (DEA) is an optimization method of multi-criteria decision-making methods that belong to. DEA method is based on Farrel model for measuring the effectiveness of units with one input and one output which has been modified and expanded by Charnes, Cooper and Rhodes (1981) and Banker, Charnes and Cooper (1984). The DEA is based on the production function estimation techniques of linear programming. DEA models are based on the fact that to the problem exists the set of allowable options consisting of all possible (acceptable) combinations of inputs and outputs. It is intended by "efficient frontier". Production units, whose combination of inputs and outputs is on the efficient frontier, are effective units, because it is not expected that could realistically be a unit that reaches the same output with fewer inputs, or higher output with lower inputs (Charnes et al. 1994; Jablonský, Dlouhý, 2004). The coefficient of technical efficiency, which we obtain by the calculation of DEA model is relative, it expresses the efficiency unit within the unit group.

Benchmarking represents a way of finding quality and achieving success on the basis of organic growth, i.e., growth that is based on your own performance (Karlöf, Östblom, 1995). Nenadál et al. (2011) state that "*benchmarking may not be only a match, but also the measurement, since we should be able to not only identify specific gaps in our performance or of our partners, but we should be able to quantify the size of these gaps (differences) as well*".

For decision-making processes is of great importance a system approach to problem solving. Systems theory, system analysis is another important approach derived from the gradual decomposition of the subsystems and elements, it deals with the transformation of inputs into outputs, i.e. the system on the behaviour and properties of systems.

3. Sustainability and integrated reporting – Current state of research

3.1. Sustainability reporting

The international organization Global Reporting Initiative (GRI) proposed the *Sustainability reporting* (G3 and G3.1 Guidelines), which were updated in 2013 to GRI's fourth generation of Sustainability Reporting Guidelines G4 (G4 Guidelines, 2013a, 2013b). This update was made to generalize G3.1 Guidelines and get more qualified G4 Guidelines that consists of two parts: *Reporting Principles and Standard Disclosures* (G4 Guidelines, 2013a), and *Implementation Manual* (G4 Guidelines, 2013b). Reporting Principles and Standard Disclosures explain the requirements of reporting against the framework, 'what' must be reported. Whereas Implementation Manual provides further guidance on 'how' organizations can report against G4 Guidelines criteria.

With G4 fast approaching, it's a good opportunity for companies to rethink reporting processes. While G4 has the potential to help integrate sustainability into businesses in the long-term, it may also present significant challenges for many when it comes to meeting its new expectations in the coming months.

There are also options to customize companies' existing website *Content Management Systems* (CMS) to add a field where administrators can include details of the relevant GRI indicator which is recorded within the website database. This gives the opportunity simply to link from the GRI index directly to content within the report that relates to that indicator (Popelka et al., 2013). This interactive and dynamic approach is very useful for site visitors, allowing them to understand better how GRI is embedded in the report (Kasem, Hřebíček, 2014).

3.2. Integrated reporting

The current pressure integrating financial and non-financial results of the company's activities into a single integrated reporting could also include the SVA and the EVA indicators. The development of a framework for an Integrated Reporting addresses the International Integrated Reporting Council (IIRC 2011, 2013) in the cooperation with the GRI and with other international organizations (A4S, IFAC, IASB, FASB, UNEPFI, the UN Global Compact, CDSB, IOSC, WWF), and the World Business Council for Sustainable Development (WBCSD). It is anticipated that this new reporting framework will bring greater consistency to corporate reporting and will contribute to the harmonization of integrated reporting and creating new standards (Busco et al., 2013; Eccles, Krzus, 2010).

IIRC has published its IIRC Pilot Programme Yearbook 2013[‡] providing insights into how those responsible for sustainability within companies are moving towards integrated reporting as part of the IIRC's pilot programme. The document provides insights on how entities have considered the "capitals" concept in integrated reporting, how integrated reporting impacts the way companies define value, the critical nature of an entity's business model, the impact of integrated reporting on investors, and the developing regional networks supporting integrated reporting

4. Future research directions

Currently wide deployment of *information and communication technologies* (ICT) generally opens possibilities to employ for modelling advanced quantitative methods (as optimization, stochastic and dynamic programming, data extraction, etc.), but also the further to implement other methods of contemporary mathematics (as neuron networks, genetic algorithms, data mining etc.), whose availability in economy is increasing.

An indispensable tool is presented by the rapidly developing ICTs. A great number of ICTs exists at present, e.g. the modelling tools MATLAB, Maple, MuPAD, Mathematica, statistician systems Statgraphics, Statistica, SPSS and others. Scientific computing thus plays an ever more important role with the rapidly developing ICTs (Gander, Hřebíček, 2004). All of these systems support mathematical disciplines and their applications in the technical and socio-scientific disciplines. Scientific computing and have played an increasingly important role (Chvátalová, Šimberová, 2011). As regards statistical methods inputs into researches, creation of new fuzzy stochastic models is essential at present for the description and evaluation of sets of numerical and linguistic data of chance nature with dominating indeterminateness, creation of unconventional mathematic-statistical methods for fitting discrete distributions of probability aimed at categorical analysis including the testing of statistical hypotheses and multi-criteria decision-making and software implementation of developed methods and their application to real data and information sets (Karpíšek, 2008).

The selecting of right software supports significant computations, statistics and graphical outputs (as visualization, animation, simulation etc.) in the way to the new research method and to its right application.

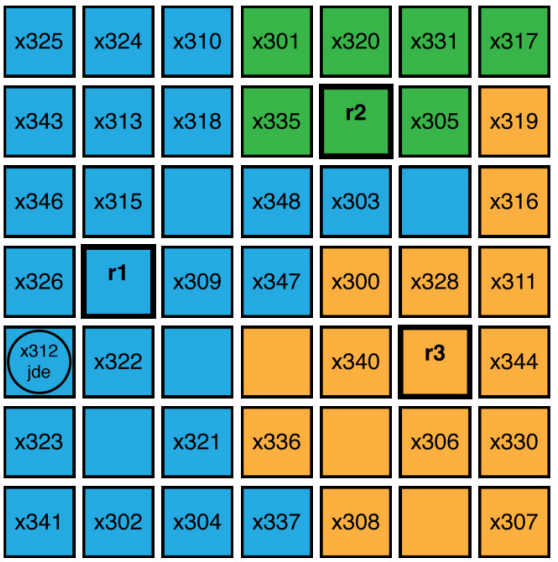
We introduce this approach to economic modeling with neuron networks.

[‡] http://www.theiirc.org/wp-content/uploads/2013/11/IIRC-PP-Yearbook-2013_PDF-3-PAGES.pdf

4.1. Economic modeling with neuron networks

Artificial neural networks are essentially based on biological fundaments whilst boasting a very good learning ability (Haykin, 2009). According to the nature of learning, they can be divided into neural networks learning using a teacher or ones learning without a teacher (Russel, Norwing, 2010). The most frequent representative of networks based on learning using a teacher (the model's inputs and outputs being known) are the Multi-Layer Perceptron (MLP) networks along with the Back-Propagation algorithm (Škorpil, Šťastný, 2006). In contrast, networks based on the principle of learning without a teacher, namely self-organized networks (Self-Organizing Map), do not need a counselor-teacher for their learning process, and are based on an algorithm similar to that of cluster-analysis (Kohonen, 2001).

In the economic sphere, neural networks may be used to an advantage as decision-making models (Kaastra, Boyd, 1996). In general, we may be dealing with tasks of classification, prediction and approximation (Johnsson, 2012). Amongst classification tasks, we may find, for instance, the evaluation of companies' financial situation using the available financial indicator analysis, as has been stated in Konečný, Trenz and Svobodová (2010) paper. The access of neural networks, the assembled model, enables us to evaluate the situation without simplifying and in a shorter time-frame than an expert in the given area would be able to. For a more detailed treatment of the problem of neural networks, including their economic and other applications introduced Konečný and Trenz (2009).



M(r1) = {x302, x304, x309, x310, x312, x313, x315, x318, x321, x322, x323, x324, x325, x326, x327, x333, x334, x337, x338, X341, x343, x346, x349, x350}

M(r2) = {x301, x303, x305, x317, x320, x329, x331, x335, x345, x347, x348}

M(r3) = {x300, x306, x307, x308, x311, x314, x316, x319, x328, x330, x332, x336, x339, x340, x342, x344}

Distance 'r1' from all 'r'

r1	r1	0.0000
r1	r2	4.9990
r1	r3	5.6418

Fig. 1. Classification into three groups, (Konečný, Trenz, Dvořáková, 2011)

On Fig. 1 we can see the function of client-satisfaction evaluation done with clients who have contracted insurance (Konečný, Trenz, Dvořáková, 2011). The graphic image shows the division of the reviewed samples into three groups, including listing the representatives (identifiers) of these clusters. The samples belong to further groups specified according to their nature, r1 – content customers, r2 – fairly content customers, r3 – unhappy customers. Based on the evaluation of the sample from the representative, including the graphic evaluation of the state, we may further employ an adequate segmented customer-approach, with the aim of keeping customers' goodwill. The graphic display, along with the evaluation of the distance of the concrete example from the group representative, enables us to identify the present customer preferences. There are several ways in which to identify these preferences (Apeh, Gabrys, Schierz, 2014), the visualization we have performed here enables a quick quality-based evaluation of the given case.

Neural networks enable a simple and quick source-data evaluation based on an adequately composed decision-model (Skapura, 1996). At present, they are a very accessible technology, and are being implemented in many technical and economical applications, including the prediction of aspects connected with selecting the given version (Garcia, Kirschen, 2004). The knowledge of this issue facilitates their implementation and this even with respect to increasing the company's management efficiency and increasing its profitability (Neely, 2002).

5. Conclusion

Over the last decade, many excellent contributions to research on corporate sustainability performance measurement have been made. This paper is focused introducing the current state and future perspectives of economic modelling of sustainable corporate performance and reporting.

In the paper we have described the implementation of neural networks in select cases of economic problem modelling. Their use enables companies to effectively and quickly solve decision-making problems, and thus to make their management more effective. A necessary condition is, however, is that historical data of the given situation are available. As we have inferred, the overlap into company administration is independent area, and this with regard to the stabilization of the company on the market and preventing its decline.

It is recognized that some of the questions presented in the paper may require further refinement and that additional questions are possible. For example, the paper did not address corporate sustainability performance indicators at the market-level nor did it focus on the issue of instituting mandatory indicators in some or all industry sectors. These topics, and others, provide a source for many other potential research questions. For example, future research on market level sustainability performance measurement could focus on.

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References

Apeh, E., Gabrys, B., Schierz, A. 2014. Customer profile classification: To adapt classifiers or to relabel customer profiles? *Neurocomputing* 132 (20): 3–13. ISSN 0925-2312.

Banker, R.D., Charnes, R.F., Cooper W.W. 1984. Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis, *Management Science*, 30 (9): 107871092.

Bassen, A., Kovacs, A.M. 2008. Environmental, Social and Governance Key Performance Indicators from a Capital Market Perspective, *Zeitschrift für Wirtschafts und Unternehmensethik*, 9 (2): 182–192.

Busco, C., Frigo, M.L., Riccaboni, A., Quattrone, P. 2013. *Integrated Reporting: Concepts and Cases that Redefine Corporate Accountability*. Heidelberg: Springer. 364 p. ISBN 978-3-319-02167-6.

Eccles, R.G, Krzus, M.P. 2010. *One Report: Integrated Reporting for a Sustainable Strategy.* New Jersey: John Wiley & Sons. ISBN 978-0-470-58751-5.

Fábry, J. 2007. Dynamic Messenger Problem, *Communications,* 9 (4): 66–69.

Färe, R., Grosskopf, S. 2000. Network DEA, *Socio-economic planning sciences*, 34 (1): 35–49.

Figge, F., Hahn, T. 2002. *Sustainable Value Added – Measuring Corporate Sustainable Performance Beyond Eco-Efficiency,* Lüneburg: Centrum Für Nachhaltigkeitsmanagement, 30 p., ISBN 978-3-935630-19-1.

Figge, F., Hahn, T. 2004. Sustainable Value Added – Ein Neues Maß Des Nachhaltigkeitsbeitrags Von Unternehmen Am Beispiel Der Henkel Kgaa, *Vierteljahrshefte Zur Wirtschaftsforschung*, 73 (4): 126–141.

Figge, F., Hahn, T. 2004a. Sustainable value added measuring corporate contributions to sustainability beyond eco efficiency. Ecological Economics, 48(2),173–187.

GACR403, 2013. Project GAČR P403/11/2085, Construction of Methods for Multifactor Assessment of Company complex performance in selected sector. [online] Available: http://www.gacr403.cz/en/.

Garcia, M., Kirschen, D. S. 2004. Forecasting System Imbalance Volumes in Competitive Electricity Markets, *IEEE Zransactions on Power Systems*, 21 (1): 240–248. ISSN 0885-8950.

Gander, W., Hřebíček, J. 2004. Solving Problems in Scientific Computing Using Maple and MATLAB. 4th ed. Heidelberg: Springer, 476 p. ISBN 3-540-21127-6.

Garz, H., Schnella, F., Frank, R. 2010. *KPIs for ESG. A Guideline for the Integration of ESG into Financial Analysis and Corporate Validation* [online]. Available: http://www.dvfa.de/files/die_dvfa/kommissionen/non_financials/application/pdf/ KPIs_ESG_FINAL.pdf.

Grigoroudis, E., Orfanoudaki, E., Zopounidis, C. 2012. Strategic performance measurement in a healthcare organization: A multiple criter ia approach based on balanced score, *Omega*, 40 (1): 104–119.

GRI, 2014. Global Reporting Initiative. [online]. Available: https://www.globalreporting.org/.

Guo, P., Tanaka, H. 2001. Fuzzy DEA: a Perceptual Evaluation Method, *Fuzzy Sets and Systems,* 119(1): 149–160.

G4 Guidelines, 2013a: Reporting principles and standard disclosures, [online] Available: https://www.globalreporting.org/reporting/g4/.

G4 Guidelines, 2013b: Implementation manual, [online] Available: https://www.globalreporting.org/reporting/g4/.

Hahn, T., Figge, F., Barkemeyer, R. 2007. Sustainable Value Creation Among Companies in the Manufacturing Sector, *International Journal of Environmental Technology and Management,* 7 (5/6): 496–512.

Haykin, S. 2009. *Neural networks and learning machines*. 3rd ed. Upper Saddle River, N.J.: Pearson, 934 p. ISBN 01-312-9376-1.

Healy, N. 1994. The transition economic of central and eastern Europe ☆: A political, economic, social and technological analysis. *The Columbia Journal of World Business*. 29 (1): 62–70.

Hill, T., Westbrook, R. 1997. SWOT Analysis: It's Time for a Product Recall. *Long Range Planning*. 30(1): 46–52.

Hřebíček, J., Soukopová, J., Štencl, M., Trenz, O. 2011. Corporate Key Performance Indicators for Environmental Management and Reporting, *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 59 (2): 99–108.

Hřebíček, J., Popelka, O., Štencl, M., Trenz, O. 2012. Corporate Performance Indicators for Agriculture and Food Processing Sector, *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* 60 (4): 121–132.

Charnes, A., Cooper, W. W., Rhodes, E. 1981. Evaluating program and managerial efficiency: an application of data envelopment analysis to program follow through. *Management science*, 27 (6): 668–697.

Charnes, A., Cooper, W. W., Lewin, A. Y., Seiford, L. M. (Eds.). 1994. *Data envelopment analysis: Theory, methodology, and applications*. Boston: Kluwer. 519 p. ISBN 0-7923-9480-1.

Chvátalová, Z., Šimberová, I. 2011. Economic Phenomena Via Mathematical Modelling in Maple System. *Business, Management and Education*, 9 (2): 260–276.

IIRC. 2011. Towards Integrated Reporting: Communicating Value in the 21st Century. Integrated reporting <IR> [online]. Available: http://theiirc.org/wp-content/uploads/2011/09/IR-Discussion-Paper-2011_spreads.pdf.

IIRC. 2013. The International <IR> Framework. [online]. Available: http://www.theiirc.org/wp-content/uploads/2013/12/13-12-08-THE-INTERNATIONAL-IR-FRAMEWORK-2-1.pdf.

Jablonský, J., Dlouhý, M. 2004. *Modely hodnocení efektivnosti produkčních jednotek*, Praha: Professional Publishing, 183 s. ISBN 80-86419-49-5.

Johnsson, M. 2012. *Applications of Self-Organizing Maps*. USA: InTech. ISBN 978-953-51-0862-7.

Karlöf, B., Östblom, S. 1995. *Benchmarking,* Praha: Victoria Publishing, 136 s., ISBN 80-85865-23-8.

Karpíšek, Z. 2008. *Zadeh-Type Fuzzy Probability with Triangular Norms,* In: Proceedings. East West Fuzzy Colloquim, p. 126-133, ISBN 3-9808089-9-8.

Kasem, E., Hřebíček, J. 2014. ICT Tools for Sustainability Reporting (to appear).

Kaastra, I., Boyd, M. 1996. Designing a neural network for forecasting financial and economic time series. *Neurocomputing, Financial Applications*, Part II, 10 (3): 215–236. ISSN 0925-2312.

Kocmanová, A., Dohnal, M., Meluzín, T. 2011. Qualitative Simple Equationless Models as Simple Integrators of Vague Sustainability Knowledge Items, *Transformations in Business& Economics*, 11 (3): 187–196.

Kocmanova, A., Hřebíček, J., Dočekalová, M., Hodinka, M., Hornungová, J., Chvátalová, Z., Kubálek, T., Popelka, O., Šimberová, I., Topolová, I., Trenz, O. 2013. Měření výkonnosti podniku. Brno: Littera. ISBN 978-80-85763-77-5.

Kohonen, T. 2001. *Self-organizing maps*. 3rd ed. Berlin: Springer-Verlag. 501 p. ISBN 35-406-7921-9.

Konečný, V., Trenz, O., Svobodová, E. 2010. Classification of companies with assistance of self-learning neural networks. *Agricultural Economics*. v. 56, no. 2, p. 51–58. ISSN 0139-570X.

Konečný, V., Trenz, O. 2009. *Decision support with Artificial Intelligence*. 1. vyd. Brno: MZLU in Brno. Folia, no. 8. ISBN 978-80-7375-344-3.

Konečný, V., Trenz, O., Dvořáková, D. 2011. Evolution of insurance company service quality survey, using self-learning neural network. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*. no. 2, p. 149–154. ISSN 1211-8516.

Křen, J., 2011. Metodika hodnocení trvalé udržitelnosti systému rostlinné produkce pro podmínky ČR. Brno: Mendelova univerzita v Brně. ISBN 978-807375-588-1.

Lee, H., Park, Y. 2005. An International Comparison of R&D Efficiency: DEA Approach, *Asian Journal of Technology Innovation*, 13 (2): 207-221.

Neely, A. 2002. *Business performance measurement: theory and practice*. Cambridge: Cambridge University Press. 366 p. ISBN 05-218-0342-X.

Nenadál, J., Vykydal, D., Halfarová, P. 2011. *Benchmarking: mýty a skutečnost: model efektivního učení se a zlepšování*, Praha: Management Press, 265 s., ISBN 978-80-7261-224-6.

Popelka, O., Hodinka, M., Hřebíček, J., Trenz, O., 2013. Information System for Global Sustainability Reporting. In Environmental Software Systems. Fostering Information Sharing, 10th IFIP WG 5.11 International Symposium, ISESS, Neusiedl am See, Austria, October 9–11, 2013. Proceedings. Heidelberg: Springer, pp. 630–640, ISBN 978-3-642-41151-9.

Qi, L. 2011, A review of economic value added (EVA) survey—From the aspects of theory and application. In Communication Software and Networks (ICCSN), 2011 IEEE 3rd International Conference on 507–509.

Russel, S., Norwing, P. 2010. *ArticialIntelligence: A ModernApproach*. 3rd edition. Uppe-rSaddle River: PearsonEducation. ISBN 0-13-207148-7.

SAFA Guidelines, 2013. Sustainability Assessment of Food and Agriculture systems. SAFA Guidelines version 2.0, [online] Available: http://www.fao.org/nr/ sustainability/sustainability-assessments-safa/en/.

Scott, J., Carrington, P. J. 2011. *The SAGE handbook of social network analysis*. SAGE publications.

Searcy, C. 2012. Corporate sustainability performance measurement systems: A review and research agenda. *Journal of business ethics*, 107 (3): 239–253.

Sharma, A. K., Kumar, S. 2010. Economic Value Added (EVA)-Literature Review and Relevant Issues. *International Journal of Economics & Finance*, 2 (2): 200–220.

Skapura, D. 1996. *Building Neural Networks*. England: Addison-Wesley Professional. 286 s. ISBN 02-015-3921-7.Stern, J., Stewart, G. B. 1994. EVA Roundtable. *Journal of Applied Corporate Finance*, 7 (2): 46–70.

Škorpil, V., Šťastný, J. 2006. Back-Propagation and K-Means Algorithms Comparison. In 2006 8th International Conference on SIGNAL PROCESSING Proceedings. Guilin, China, IEEE Press, p. 1871-1874. ISBN 978-0-7803-9736-1.

Tseng, Y.F., Lee, T.Z. 2009. Comparing Appropriate Decision Support of Human Resource Practices on Organizational Performance with DEA/AHP Model. *Expert Systems with Applications*, 36 (3): 6548-6558.

Zhu, J. 2003. *Quantitative Models for Performance Evaluation and Benchmarking: Data Envelopment Analysis with Spreadsheets and DEA Excel Solver*, Kluwer academic publishers, 297 p., ISBN 1-4020-7082-9.

Zhu, J.2009. *Quantitative Models for Performance Evaluation and Benchmarking: DEA with Spreadsheets*, Boston: Springer, 323 p., ISBN 978-0-387-85981-1.